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(54) Abstract Title
Material for protective padding

(57) Material for protective padding comprises a base layer 8 of flexible fabric, an impact absorbing layer formed from a plurality of resilient pads 9 and a loricated armour layer formed from shaped plates 5 of an impact resistant material. In a further embodiment a layer 10 of stretchable fabric is interposed between the loricated armour layer and the resilient pads 9; alternatively the flexible fabric 10 may be over the outer surface of the loricated armour (as fig. 5). The material has applications in eg. sport, industrial clothing and as military armour.

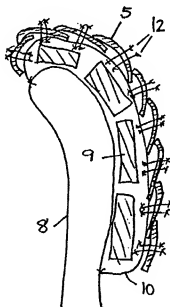


Fig. 3

GB 2 368 775 A

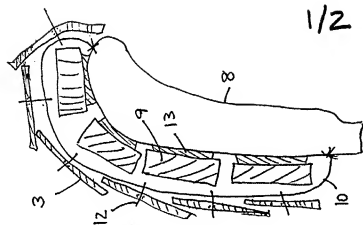


Fig. 4

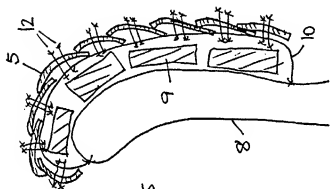


Fig. 3

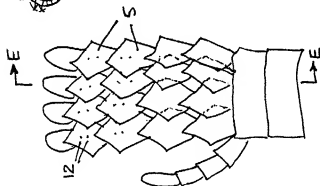


Fig. 2

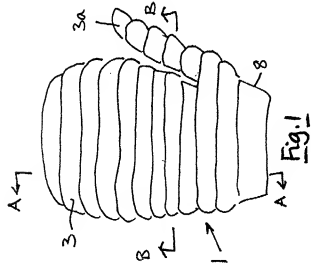


Fig. 1

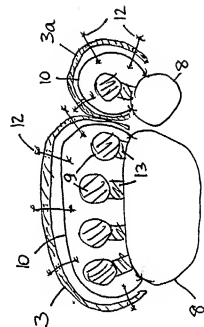
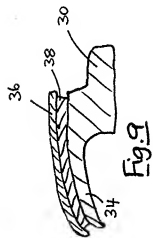
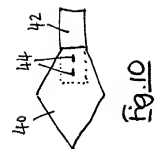
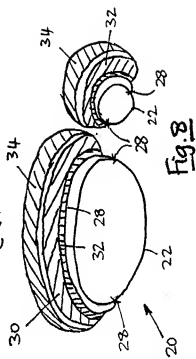
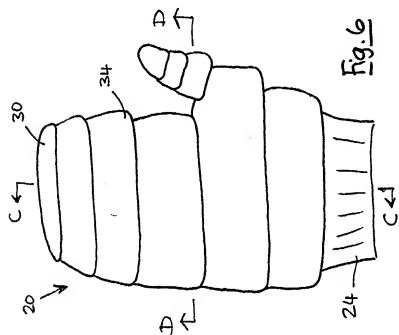
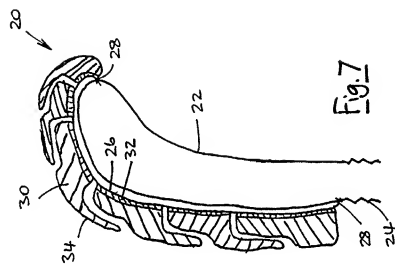


Fig. 5



5 MATERIAL FOR PROTECTIVE PADDING AND PROTECTIVE CLOTHING
OR EQUIPMENT FORMED FROM SUCH MATERIAL.

10 This invention relates to padding for protection against the impact of an object impinging on such padding. More particularly it relates to such material and to protective clothing or equipment for sports or industrial use formed from such material.

15 Such padding is extensively used for sports equipment, such as pads to protect the legs, gloves, shoulder pads, and clothing to protect larger parts of the body, in such sports as cricket, field and ice hockey, American football, and any other sport involving impact from a
20 hard ball, or another player. Participants in speed sports, such as motor cycling, may use such padding also. Law enforcement agencies, such as the police, make use of such protection for the purposes of riot control. Some protection against impact is also needed in some
25 industries. There is also a minor need for armour for theatrical purposes (stage, cinema or television) and for the purposes of historical re-enactment.

There are forms of military armour that permit a
30 reasonable degree of flexibility of a wearer's limbs. Among these are mail or plate armour, where the metal protection may be worn with, or attached to, flexible garments, e.g. of leather. Other forms allowing flexibility are reminiscent of the skins of fish or

- reptiles, or of pangolins, in the form of scale armour, in which the protection is provided by rows of small plates, generally having curved or pointed lower edges overlapping a joint between the plates of the adjacent
- 5 lower row. Another form of armour reminiscent of animals is lamellar armour, which has rows of narrow strips parallel to one another, in the manner of the armour of armadillos. Lamellar armour is generally more flexible than scale armour: the best known form of such armour is
- 10 Japanese armour. In both scale and lamellar armour, the armour plates are attached to a flexible garment.

- The most common form of impact padding for sporting use comprises relatively stiff boards, such as of plastics
- 15 material, with padding fixed to the back. These are normally held in place by elasticated straps, or by straps and buckles. More sophisticated equipment is needed for gloves, e.g. for cricket, where cricketers have for many years made use of bulky and largely
- 20 inflexible finger guards (sausage gloves). Some cricket gloves have a full pad for the back of the hand, to which fingers are attached.

- One important recent development for cricket gloves has
- 25 been the introduction of overlapping plates covering the finger portions most exposed to impact. These plates are attached directly to the fabric of the gloves, generally by stitching, and do not allow easy finger movement.

- 30 There is still, however, a need for materials which provide protection against impact and which allow a high degree of flexibility to the wearer of a garment made from such a material.

One embodiment of the present invention provides material for protective padding which comprises:

- (a) a base layer of flexible fabric,
- 5 (b) an impact-absorbing layer carried over the base layer and formed from a plurality of adjacent resilient pads, and
- (c) a loricated pad-spanning impact-resistant layer carried over the resilient pads.

10

The pad-spanning layer (c) may be formed from the combination of (d) a layer of stretchable fabric, and (e) a loricated armour layer formed from shaped plates of an impact-resistant material. The plates will normally be
15 individually attached to the stretchable fabric, with sufficient overlap, having regard to the likely extent to which the fabric will be stretched in use, to avoid separation of the overlapping plates.

- 20 Alternatively, the pad-spanning layer (c) may be formed by lateral projections from the pads, overlying adjacent pads. Such lateral projections may be integrally formed with the pads, or affixed to the pads by rivets, stitching, or adhesives or the like. A lateral
25 projection from a pad that is formed from the same or a similar impact-absorbing material may be provided with an additional superficial armour layer, formed by one or more shaped plates or otherwise. These may be attached to the projections, or provided by additional layers (d) and (e).
- 30

The proximity of adjacent pads, which will vary in use as the material is flexed, helps to determine the lateral extent of the elements of the pad-spanning impact-

resistant layer, which serves to spread an impact over more than one pad and to guard against penetration between adjacent pads.

- 5 According to various preferred embodiments of the invention:

the base layer is formed from a woven, non-woven, or knitted fabric;

10

the impact-absorbing layer is formed from natural or synthetic rubber, closed-cell plastic foam, gel-filled tubes or cushions or a quilted fabric;

15

the shaped plates are formed from a plastics material, a reinforced plastics material or a metal; and

20

when layer (c) is formed by combining the two layers (d) and (e), the layers forming the material can be arranged in the order (a), (b), (d), (e), with layer (e) forming the surface of the material, or alternatively in the order (a), (b), (e), (d), with layer (d) forming the surface of the material.

25

The present invention also provides protective clothing or equipment comprising an article of clothing or of safety equipment formed from a material as described above.

30

The present invention will be further described with reference to the accompanying drawings, in which:

Figure 1 is a view of the back of a left hand cricket

glove according to one embodiment of the invention;

Figure 2 is a view of the back of a right hand cricket
glove according to an alternative embodiment of the
5 invention;

Figure 3 is a section along the line E__E of Figure 2;

Figure 4 is a section along the line A__A of Figure 1;
10

Figure 5 is a section along the line B__B of Figure 1;

Figure 6 is a view of the back of a left hand cricket
glove according to a further embodiment of the invention;
15

Figure 7 is a section along the line C__C of Figure 6;

Figure 8 is a section along the line D__D of Figure 6;

20 Figure 9 is a cross-sectional view of an alternative pad
which carries integrally the loricated pad-spanning
impact-resistant layer; and

Figure 10 is a plan view of a single pentagonal plate
25 affixed to a pad.

Referring now to the drawings, it will be seen from
Figure 1 that the outer layer of that part of the glove
that is intended to cover the back of the hand (1) and
fingers, i.e. the portion of the hand that will be
30 directly exposed to impact from a cricket ball, is
composed of a series of plates of armour in the form of
substantially parallel strips (3). These provide the
primary impact resistance, and may be made from a

material that combines strength adequate to resist an impact of the force to be expected from a cricket ball with lightness so as not to be unduly onerous to the wearer. The strips (3) can for example be formed of a

5 light metal, such as an aluminium alloy, or from a plastics material, such as a polyolefin. Advantageously such a plastics material may be reinforced with a filler, preferably a fibrous filler such as randomly-distributed or matted short fibres, or longer fibres which may be in

10 the form of a woven fabric or may be laid in parallel. The fibres may, if desired, be in multiple layers. As may be seen more clearly in Figure 4, the strips should overlap, preferably with the strips near the finger tips overlapping those nearer the wrist. The strips (3) may be

15 flat or slightly curved in cross section, although that covering the finger tips is preferably more arcuate in cross section, as may be seen from Figure 4. As seen in longitudinal section, as in Figure 5, the strips (3) covering the fingers are curved, so as to provide

20 protection from glancing blows at the side of the hand. The strips (3a) providing protection for the thumb, as will be seen from Figure 5, are more sharply curved in longitudinal section.

25 These strips are fastened to a layer (10) of a stretchable fabric, as shown in Figures 4 and 5. This fabric may, for example, be made from a synthetic elastomeric fibre, such as that sold under the trade names Elastane, Spandex or Lycra. The method of fastening

30 may be, for example, rivets (12) of plastic or rubber, stitching, glue, or a hot melt resin. The method by which the strips (3) are fastened to the fabric is not critical, any method that is convenient and able to support the strains to which the material is subjected

may be used.

The stretch fabric layer (10) is stitched to the base layer (8) around the edges, and optionally between two or more of the fingers. Between the stretch fabric (10) and the base layer (8), there is located the impact-absorbing layer of resilient padding that provides absorption of the force of impact. This resilient padding is formed from adjacent pads (9) of natural or synthetic rubber, plastic foam (preferably closed cell foam to avoid water absorption), gel-filled tubes or cushions, a quilted fabric, etc. These pads are not fastened to the layer of stretchable fabric (10), but are fastened to the base layer (8), most conveniently by means of an adhesive (13). These pads lie over each carpal and metacarpal bone, so that the fingers may be flexed, extra protection may be provided by means of bubble film.

The pads (9) may be made in various patterns, shapes, and sizes, but it is important that notice should be taken of two factors when considering those portions of padding intended to protect the outside angle of body joints as they are bent:

(i) The pads should be sufficiently close together when the joint is relaxed, and of sufficient thickness. They may, for instance, be located in a tessellated or any interlocking pattern, so as to provide adequate coverage when the joint is flexed, which would separate the pads. Excessive spacing between the pads, or pads which are too thin, could allow the plates of armour to come into contact with the joint through the base layer.

(ii) The pads should not lie on that portion of the joint

where bending is at a maximum, thus impairing movement.

If the inside angles of joints are to be protected, e.g. the backs of knees, the reverse of the above-mentioned factors (i) and (ii) will apply, so that protection is maintained when the joint is straightened.

In the embodiment shown in Figures 2 and 3, smaller individual plates (5) are used instead of plates formed as strips (3). These are generally in the form of irregular pentagons, arranged in substantially parallel ranks, with the pentagons in each rank overlapping, or being overlapped by, adjacent pentagons in the same rank, and with the pentagons in adjacent ranks. In the case of overlap between the pentagons of adjacent ranks, the points of the pentagons of one rank preferably overlap the adjacent rank along the bases. In this embodiment, the pentagons are attached top the stretch layer (10) in the same way as the strips (3), but each pentagon must be fixed in at least two positions, so as to maintain the orientation of the individual pentagons.

The protection has been described with reference to the accompanying drawings, with the plates of armour outside the layer (10) of stretch fabric. It is also possible, however, to invert this order and to have layer (10) as the outer layer.

In either embodiment the plates can be of any shape or contour, provided they overlap when in use. For example, pentagonal plates may be replaced by circular plates, which provide an alternative that may be easier to manufacture.

In the embodiment shown in Figures 6 to 8, a glove (20) is formed from an inner base fabric (22) with a knitted cuff (24), to which base is sewn a loose sleeve (26) of stretch fabric around its edges. The stretch sleeve carries a plurality of adjacent resilient pads (30) of mouldable material with impact-absorbing properties, such as natural or synthetic foam or solid rubber, each attached to sleeve (26) by an adhesive layer (32).

10 In this embodiment, pads (30) are moulded to include a pad-spanning layer formed by lateral projections (34) which overlie, in part, the adjacent pad on that corresponding side. The projections can be sufficiently stiff to spread an impact over the two adjacent pads and
15 to prevent or inhibit penetration between the pads, and so provide an armouring effect.

For further simplification of the structure, the pads (30) may be affixed directly to the base fabric (22).

20 Figure 9 illustrates the use of a harder and stiffer superficial armour plate (36) affixed to a projection (34) by adhesive (38). The curvature of the projection and plate, which is desirable in order to minimise the appearance of any gaps in the pad-spanning layer on
25 flexing the garment, is clearly shown.

Figure 10 illustrates, as an example, a single pentagonal plate (40) as a lateral projection from a small pad (42).
30 In this construction, the two are directly connected by stitching at (44), with no intermediate stretchable fabric layer.

The material according to the present invention may be employed for any form of padding against impact, but also against pressure. It may, for instance be used as knee pads or elbow pads when performing such activities as
5 housework or gardening. Its application to gloves is shown herein merely as an example.

CLAIMS

- 1 Material for protective padding which comprises:
 - (a) a base layer of flexible fabric,
 - (b) an impact-absorbing layer carried over the base layer and formed from a plurality of adjacent resilient pads, and
 - (c) a loricated pad-spanning impact-resistant armour layer carried over the resilient pads.
- 2 Material as claimed in claim 1 wherein the layer (c) is formed from the combination of (d) a layer of stretchable fabric and (e) a loricated armour layer formed from shaped plates of an impact-resistant material.
- 3 Material as claimed in Claim 2 wherein the layers are arranged in the order (a), (b), (d), (e), with layer (e) forming the surface of the material.
- 4 Material as claimed in Claim 2 wherein the layers are arranged in the order (a), (b), (e), (d), with layer (d) forming the surface of the material.
- 5 Material as claimed in claim 1 wherein the layer (c) is formed by lateral projections from the pads, overlying adjacent pads.
- 6 Material as claimed in claim 5 wherein the lateral projections carry shaped plates of an impact-resistant material.

- 7 Material as claimed in any of claims 2, 3, 4 and 6 wherein the shaped plates are formed from a plastics material, a reinforced plastics material, or a metal.
- 8 Material as claimed in any one of the preceding claims wherein the base layer is formed from a woven, non-woven, or knitted fabric.
- 9 Material as claimed in any one of the preceding claims wherein the impact-absorbing layer is formed from pads of natural or synthetic rubber, plastic foam, gel-filled tubes or cushions, or a quilted fabric.
- 10 Protective clothing or equipment comprising an article of clothing or of safety equipment formed from a material as claimed in any of the preceding Claims.
- 11 Material for protective padding substantially as herein described with reference to and as illustrated in any of the accompanying drawings.
- 12 Protective clothing or equipment substantially as herein described with reference to and as illustrated in any of the accompanying drawings.



INVESTOR IN PEOPLE

Application No: GB 0027652.7
Claims searched: 1-12

Examiner: Peter Mason
Date of search: 14 December 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): A3V:

Int Cl (Ed.7): A41D: 13/00, 13/015, 13/08, 19/015, 31/00
A63B: 71/08, 71/10, 71/12, 71/14
F41H: 1/02

Other: Online: JAPIO, EPODOC, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2328859 A WHITE (See paragraph page 8 and figs. 13-15)	1
A	GB2238460 A PERSONNEL ARMoured DESIGNS Ltd. (See whole document especially figs. 1-4)	-
X	GB2171893 A WOODS (See page 2 lines 34-53 and fig. 4)	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.